



## The impact of gender difference on agricultural productivity in the case of Bambasi woreda in Benishangul Gumuz Regional State, Ethiopia

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### Abstract

*This study focused on the impact of gender difference on agricultural productivity in Bambasi Woreda. Therefore, agriculture is the engine of growth especially in low – income countries of the world but it highly depend on rainfed and its productivity is low. Besides, gender discrimination exists as parts of the social system and runs via all aspects of life and different levels such as at family level, community level and institutional level. As a result, the objective of this paper is to investigate the impact of the gender difference on agricultural productivity in Bambasi Woreda of four kebeles.*

**Keywords:** Gender, Gender difference, agricultural productivity, Tobit Model, Bambasi Woreda.

### 1. Introduction

In Africa agricultural sector plays a decisive role during the initial stage of development. Furthermore, agriculture has a high multiplier effects on the rest of the economy which ranges from 1.5 percent to 2.7 percent. Explicitly, a one dollar increase in agricultural income would lead to on an average increase in aggregate income of more than two dollar's. particularly, agricultural sector in Ethiopia accounts for 70 percent of the labor force, over 25 percent of Gross Domestic product ( More an 40 percent in countries like Ethiopia)much as 90 percent in Ethiopia), (UNECA, 2009).

Not surprisingly, Ethiopia, like other Sub-Saharan African countries, is largely an agrarian country with the vast majority of its population directly or indirectly involved in agriculture somewhere around 95% of the country's agricultural output is produced by small holder farmers (MoARD, 2010). For this reason it is the backbone of Ethiopian economy; in which it contributes about

50 percent of the GDP, 85 percent of the employment, 90 percent of the export earnings and 70 percent of the supply of industrial raw materials (World Bank, 2010). Therefore, agriculture plays a leading role in the economies of many developing countries principally in SSA including Ethiopia. Hence, it estimated human population 85 million which grows annually at about 2.7 percent; position Ethiopia to be the second most populous country in SSA next to Nigeria (Tilahun, 2011). In terms of the structure of the economy, agriculture accounts for approximately 43 to 50 percent of country GDP, up to 90 percent of export, 83.9 percent of labor employment (FTF, 2010). Besides, it is also major supplier of food to the domestic consumption in the country. Nevertheless, as it has been repeatedly stated in money studies, Ethiopian agricultural mainly depends highly in variable rainfall, equally in terms of seasonal variation and annual fluctuation, which severely affects the sectors' productivity.



### Review of Related Literature

Initially, measuring differences in agricultural productivity according to the sex of household head is complicated and may vary between different types of farming systems, social-ethnic groups and cultural institution in gender (Quisumbing, 1995). And also gender differences may also change over time according to new pressures and opportunities and way of gender relations adapt to these in the rural livelihoods (Boserup, 1970). Even the neoclassical economics theory first suggested models in which there were no individuals inside the household, but only a benevolent dictator or patriarch that made decisions on every one's behalf.

According to the study of Quisumbing (2003) and other several empirical studies have rejected the hypothesis that households act as if they are unitary. Hence, as stated by Quisumbing (1995) it is very difficult to isolate managerial efficiency differences in agricultural settings where plots are cultivated mutually by male and female household members and hired labor. The assumption dictates that, the farm manager is usually the male head of the household tends to ignore the actual contribution of woman regarding decision-making and farm labor. For instance, Boserup (1970) proposes that women's outstanding role in cultivation and harvesting in Sub-Saharan Africa is not complemented by possession of resources control over resource uses or decision-making capabilities all of which tends to be assumed within the male sphere. In similar fashion this situation has also been found in the male-run farming systems of Asia and Latin America (Quisumbing, 1995).

Deere and Leon (2003) suggested that, in Brazil, Mexico, Nicaragua and Peru, women are in the minority among land owners<sup>1</sup>. They emphasize on the sources and prevalence of land ownership by women throughout Latin America and they found that men are more likely to acquire land through market. Consequently, effective women's land rights are defined by Deere and Leon (2005) as requiring legal ownership of land by women's social recognition of that ownership and effective control by women over land that they own. That is, this meaning imposes strong information equipment for a meaningful measurement of women's rights in an empirical investigation. As the empirical productivity estimation of Jacoby (1992) revealed that, asexual division of labor implies that male and female labor are not perfectly substitutable in which women contribute more to livestock production and men contribution is highly to crop production.

### 2. Role of Gender in Agriculture

Not surprisingly, all over Africa, men and women have separate responsibilities and play different but complementary roles. Although, the gender division of labor differs considerably across border depending on culture and economic status women universally carry the most important burden of producing food and providing food daily for consumption to the family (Davidson, 1995).

### 2.3 Agricultural Production function

That is, using production function it is possible to measure technical efficiency and allocative efficiency. Thus, given technology and a set of input levels technical efficiency reveals the ability of a farmer to produce output. Accordingly, it is associated to tied with the farmer



ability to equate the level of its actual production from a given input to the maximum possible level of production that said to be allocative inefficient. Therefore, a firm with allocative efficiency minimizes the total cost of producing a given quantity by selecting a combination of factor input where the slope production is equal to the slope of the cost function. By and large, the improvement in the male farmers' efficiency over that of female farmer's could be because of the technical change or the exploitation of scale economics or from some combination of these factors (Coelli, 1998).

### 2.3 Empirical Literature Review

Structural or institution factor may contribute to gender differences in productivity as agricultural systems are modernized. A study done in Nigeria particularly Oyo state found out that the coefficient of dummy gender for male headed is negative and insignificant for the data taker farm household level, suggesting that there is different in technical between male and female farmer but where significantly higher for men when total values of production at the plot was used (Saito et al., 1999).

Furthermore, Quisumbing (1995) reviewed seven studies that estimated difference in technical efficiency between male and female farm managers or household heads using production functions and in general concluded that, male and female farmer's are equally efficient as farm managers. Despite, productivity is below potential capturing this potential productivity by improving the circumstances of women farmers would substantially increase food production in Sub-Saharan Africa, there by significantly reducing one determinate

of food insecurity in the region. Because, women produce an estimated 75 percent of Sub-Saharan Africa's food, it result from Kenya were to hold in Sub-Saharan Africa as a whole, simply expanding the productivity of women to the same level as men could increase total production by 10 percent to 15 percent (Saito and Surpling, 1992).

But, in Ethiopia there is dearth of empirical studies on gender difference in agriculture. A study conducted by Tiruwork (1998) in North Shewa and East Gojjam zone using Cobb -Douglas production function intend that female headed households are less productive than male headed households because, of lack of productive resources such as land, adult male labor and extension services. Therefore, dummy variable representing sex was one of the significant explanatory variables for North Shewa zone while not for East Gojjam zone. On aggregate, the positive and significant coefficient for male headed dummy sex in North Shewa depicted that male headed households are more technically efficient than that of female headed household.

With regard to another study conducted by Appleton and Bailouts (1996) found that a positive correlation between education and agricultural productivity. That implies education lead to a better openness to new idea and modern practices there by affecting agriculture negatively as the more qualified individuals could leave farming to look for better employment in other sector of the economy (Weir and Knight, 2004).

Furthermore, as Coelli and Battese (1996) and Wang and Cramer (1996) revealed that older farmers are less productive than younger farmers and



family size and marital status has multifaceted agricultural productivity. In addition, access to input such as quality of land, improved seed, fertilizer, Extension service and water are positively correlated with agricultural productivity (Quisumbing, 1995). And another study of Seyoum (1998) added that farmer who has access to extension service is more productive than those who have not. Peterman et al., (2010) found that, offarm income and on- farm income are both positively correlated with productivity.

### 3. Methodology of the study

#### 3.1 Source of data collection

For this study both primary and secondary data sources has been employed to collect the qualitative as well as the quantitative data type. In using the primary data the conventional household survey was the key method employed to collect the quantitative information via a well designed structured scheduled questionnaire and interview which was prepared for the study. Information pertaining to households' demographic, socio-economic characteristics and institutional situations etc. were obtained directly

through the interview and sample household heads were the unit of analysis.

#### 3.2 Sampling techniques and sample size

A multistage sampling technique is used to determine the sampling of households. First, Bambasi woreda is selected purposively because of the extensive practice of agriculture and it is the place where various agricultural crops planted and most of the regional farm households found. Due this reason the highest weight is given for the large populous farms in agricultural practice and due to its large place in kebeles composition of the region as well. Second, Bambasi woreda consists of 11,286 households and 38 kebeles. Third, of this, 4 kebeles was also selected using purposive sampling technique and the households of the four kebeles was also selected using simple random sampling technique in order to give an equal chance of the households participation to be selected and to minimize the sampling error too. Finally, the selection of the households was based on probability proportional sampling. Furthermore, to determine the sample size of this study Yamane's (1967) formula was employed as:

$$n = \frac{N}{1 + N(e)^2} \quad \text{Where, } n \text{ is the required sample size; } N \text{ is the total}$$

number of Bambasi woreda households; e is the level of precision at 92% degree of confidence. Specifically, in the four selected rural Kebeles, the total number of the households are 3586 (that is, village 45 = 896, Nebar Keshemando = 982, Sonka = 965 and Garabiche Metema = 743). The actual sample size determined is

$$n = \frac{3586}{1 + 3586(0.08)^2} = 150 \quad \text{The then, to determine each kebeles sample size using}$$

probability proportional sampling technique, is computed as follows



Table 3.1: proportional sample size determination

Kebelles	Household no	How to compute	Sample size
Village 45	896	$896 \times 150/3586$	$\approx 38$
Nebar keshamando	982	$982 \times 150/3586$	$\approx 41$
Sonka	965	$965 \times 150/3586$	$\approx 40$
Garabiche Metema	743	$743 \times 150/3586$	$\approx 31$
Total	3586	$896 \times 150/3586 + 982 \times 150/3586 + 743 \times 150/3586$	150

Source: own computation, 2015

### 3.3 Methods of data Analysis

After necessary data was collected from the respondents to analyze the data both descriptive statistics and econometrics model has been employed. After the data has been collected, edited, coded and labeled the descriptive statistics was employed to summarize the demographic and socioeconomic behavior of household characteristics using mean, standard deviation, and table.

#### 3.3.1 Theoretical and Econometrics Model specification

As part of the study, to come up with empirical model the paper employed theoretical model with regard to the Cobb-Douglas production function. So, the specification of the theoretical model is as follows: Theoretical model:-  $Y_{ij} = f(V_i, X_i, Z_j)$

Where,  $Y_{ij}$  is quantity produced,  $V_i$  is a vector of inputs used by farm manager  $i$  (including land, labor, capital and extension service);  $X_i$  is a vector of individual attributes, including gender; and  $Z_j$  are household and community level variables.

Usually gender productivity differences are estimated by using the Cobb- Douglas production function as most of the empirical studies on gender difference in

agricultural productivity do (Quisumbing, 1995).

$$Y = AL^{\alpha_1}T^{\alpha_2} \dots\dots\dots (1)$$

Where  $Y$  is output,  $L$  is labor input (hired or family), and  $T$  is vector of Land, capital, and other conventional input. Indeed, constant return to scale is frequently reasonable assumption to make about technologies. If  $\alpha_1 + \alpha_2 = 1$  the production function has constant returns to scale: doubling labor  $L$  and capital  $T$  will also double output  $Y$  (Varian, 1992).

Thus, the relationship between two or more explanatory variables and response variable is found by fitting a linear equation to the observed data (Verbeek, 2008). By making along linear transformation of equation (1) that is, natural logarithm on both side of the equation (2) below which is thus a log-log model that be estimated with the ordinary least squares (OLS) estimators.

$$\ln y_i = \alpha_0 + \alpha_1 \ln L_i + \alpha_2 \ln T_i + \beta_0 \ln E_i + \delta \text{gender}_i + \epsilon_i \dots\dots\dots (2)$$

Considering that,  $y_i$  is the dependent variable and represents the plot gross value of output per hectare by plot. Similarly,  $E_i$  is years of schooling (of the farm manager, household head or members of the household),  $\text{gender}_i$  is the gender of the household head





(dummy variable for the sex or gender of the farm manager) and  $\varepsilon_i$  is the error term.

**Econometrics Model Specification**

As part of the study, here we are concerned with the coefficient on gender while controlling for access to other input function in estimating equation (2) based on the Cobb-Douglas production function using Tobit Model to estimate the agricultural productivity. Besides, special

consideration must be given to the distribution of the outcome measure though productivity is positive and continuous indicator that we observe a mass point at zero productivity, which may occurred due a number of different reasons. Considering this factor the following Tobit model may be the most suitable estimation procedure, given the left censoring at zero of the dependent variable:

$$\ln yi^* = Gender_i + Xi\beta + \vartheta_i \text{----- (3)}$$

$$\ln yi = 0 \text{ if } \ln yi^* \leq 0 \text{----- (3A)}$$

$$\ln yi = yi^* \text{ if } \ln yi^* > 0, i = 1,2 \text{---} N \text{ and } \vartheta_i \sim N(0, \delta^2), iid \text{---} \text{---} (3B)$$

**4. Results and Discussion**

Table 4.1: summary statistics of categorical household characteristics of productivity in quintal (annually)

Variabels		Productivity in Quintal			t-value
		Obs.	Mean	Std. Dev.	
gender	Female	60	22.53	14.46	-4.71***
	Male	90	36.31	19.32	
	All Sample	150	30.8	18.749	
Pesticide_use	No	38	22.2	12.27	t = -3.4***
	Yes	112	33.73	19.68	
Electricity	No	106	30.48	18.83	t = -0.32
	Yes	44	31.57	18.74	
Credit_access	No	95	28	15.3	t = -2.44**
	Yes	55	35.64	22.9	
Social_position	No	120	31.57	19.2	t = 1.00
	Yes	30	27.73	16.9	
Fertilizer_use	No	63	27.29	17.99	t = -1.97**
	Yes	87	33.34	18.97	
Irrigation_use	No	87	30.1	19.35	t = -0.45
	Yes	62	31.5	18.02	
extensionservice	No	44	22.43	9.29	t = -3.67***
	yes	106	34.27	20.54	
Farmerfarmer_exten	No	10	17	5.79	t = -2.45**
	Yes	140	31.79	18.97	
Soilquality	Infertile	71	28	15.69	t = 1.74*
	fertile	79	33.3	20.9	

Source: Computed from own survey, 2015: Note: \*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1% probability of significance level

As the above Table 4.1, the qualitative data of the household head characteristics indicates that there is statistically significant and economically meaningful difference in terms of gender

of agricultural productivity in quintal. That is, male headed households have a mean difference of 13.78 quintal times higher than their counter parts of female. Whereas, electricity, social position and



irrigation use variables are statistically insignificant and economically meaningless. On the other hand, pesticide use is statistically significant at 1% probability level of significance and it shows a mean difference of 11.57 quintal of technical efficiency. Indeed, farms with the use of pesticide increases their technical efficiency of productivity in quintal too. Besides, the existence of access to credit is also statistically significant at 5% probability level of significance with a mean difference of

7.64 quintal increase in technical efficiency. In similar fashion, fertilizer use and farmer to farmer extension are statistically significant at 5% level of significance. And extension service is statistically significant at 1% probability level of significance since it improves the technical efficiency of the farm households. Finally, soil quality is statistically significant at 10% probability level of significance and the more of the land with soil quality increases the technical efficiency of productivity.

Table 4.2. Gender indicators and crop choices in Bambasi Woreda, Benishangul Gumuz region

Primary crop choice	Productivity in Quintal of gender			t-value
	Female Mean (SD) N = 60	Male Mean (SD) N = 90	Full Sample (SD) N = 150	
Sorghum	6.78** (5.46)	8.78** (3.79)	7.98 (4.62)	-2.64**
Maize	7.6(5.86)	8.42(4.26)	8.12(4.96)	-0.95
Pepper	8.12(7.78)	19.11(18.09)	14.71(15.77)	-4.44***

Source, own survey computation, 2015

Note: \*\*, \*\*\* statistically significant at 5% and 1% probability level of significance.

As shown in the table above, the 3 primary practiced crops are presented as indicators. In which the mean values are reported with standard deviations are in brackets. Therefore, the primary crop grown by all of the rural households especially the 150 full sample households of the Bambasi woreda is stratified by gender of the household head. Here, in the study 60 households are headed by females whereas, the remaining 90 are headed by males. From the same table, the most commonly grown crop is pepper

for around 8.12 quintal of female, 19.11 quintal of male and is statistically significant at 1% probability level of significance. As per the descriptive result shows that, pepper is the most and commonly grown crop across Bambasi woreda plots. And the combined mean difference of the pepper produced is 14.71 quintal. Male-owned plots are significantly more likely to be planted with pepper, sorghum, as compared to female owned plots.



Table 4.3 Tobit Productivity results for full sample of aggregate production, Bambasi Woreda

Variables	Coef.	Std. Err.	t - value
gender	.5498	.0954	5.76***
age	.0057	.0217	0.26
marstat	.0045	.0487	0.09
famsize	-.0032	.018	-0.18
land_hectare	.0716	.0417	1.71*
soilquality	-.060	.091	-0.66
mktaccess	.420	.3836	1.10
credit_access	.107	.0932	1.15
farmerfarmer_exten	.3617	.1888	1.92*
fertilizer_use	.04004	.0907	0.44
irrigation_use	.0419	.0946	0.44
pesticide_use	.175	.108	1.62
improvedseed_use	.0088	.0249	0.35
electricity	-.178	.1068	-1.67*
extensionservice	.038	.122	0.31
educ_yrs	.0226	.0198	1.14
social_position	-.1697	.111	-1.53
agesq	-.00009	.0002	-0.43
Inofffarm_income	.010	.012	0.85
Inonfarm_income	.104	.0386	2.70***
TLU	.0094	.010	0.92
_cons	.718	.703	1.02
sigma	.499	.0289	17.3***

Source: Own Survey data, 2015

Dependent variable = Inoutput in quintal      Number of obs      = 150  
 LR chi2 (21)      = 73.16      Prob > chi2      = 0.0000  
 Log likelihood = -107.89218      Pseudo R2      = 0.2532





\*\*\*, \*\*, and \* indicates the significance at 1%, 5%, and 10% probability level respectively.

As the above result of the Tobit model productivity in quintal indicates that, the variables like gender of the household head, land size in hectare, farmer to farmer extension, availability of electricity and natural logarithm of on farm income are statistically significant and economically meaning full that affects the technical efficiency of the natural logarithm of productivity in quintal. Consequently, with regard to the result, gender of the household head is statistically significant at 1% probability level of significance and it positively affects the natural logarithm of output in quintal. And also, as male headed household's change of technical efficiency of output produced in quintal is a 0.55 quintal times higher than their counter parts of female. Since, in the rural farm male headed households are more technically efficient in agricultural productivity. Besides, the result of this paper is consistent with the result found by (Tiruwork, 1998) in North Shewa.

Similarly, land size in hectare is statistically significant and 10% probability level of significance and it positively affects the technical efficiency of the natural logarithm of productivity in output. As a result, as the land size in hectare increases by 1hectare the technical efficiency of productivity increases by 0.07 quintal, ceteris paribus. Therefore, households with more land size are more likely to feed themselves sufficiently.

From the similar table, farmer to farmer extension and electricity are statistically significant at 10% probability of significance. Therefore, farmer to farmer extension is a proxy for information and

households with farmer to farmer extension are 0.36 quintal times more likely to increase their technical efficiency of the natural logarithm of productivity, ceteris paribus. This result is consistent with the theory that farm households with more sharing of experience or exposure improves their agricultural productivity. Hence, Seyoum (1998) added that farmer who has access to extension service is more productive than those who have not. Coincided with this, the availability of electricity is significant but it negatively affects the change in productivity in quintal. Since, the presence of electricity implies households are found in urban and then their emphasis for agricultural productivity becomes less rather they give emphasis for other non-farm private business.

Likewise, the natural logarithm of on-farm income is statistically significant at 1% probability level of significance and it positively affects the technical efficiency of the natural logarithm of productivity in quintal. As the on farm income changes by one birr the technical efficiency of output changes by 10.4 quintal, other things remain constant. So, this result is consistent with the result done by (Sito, 1994) and Peterman et al., (2010) found that, offarm income and on-farm income are both positively correlated with productivity.

According to the above Table, the overall fit of the model (Pseudo R<sup>2</sup>) is significant at 1% probability level of significance. Therefore, we can be 25.32% confident that the regression's line fit and approximately all the explanatory variables in the model explains the



natural logarithm of productivity. The likelihood ratio/Wald Chi2 test estimate is 73.16, so, the researcher rejects the null hypothesis which states that all the coefficients are simultaneously equal to zero that is none of these potential factors affect natural logarithm of productivity. Therefore, the researcher rejected the hypothesis at 1% probability level of significance. And the log likelihood of the Tobit on the natural logarithm of productivity is -107.89, which corresponds to the value of the log likelihood at convergence. The  $\text{prob} > \text{Chi2} = 0.0000$  gives the p-value which indicates the significance at the 99% probability level as.

#### 5. Conclusion and Policy Implication

Based on the analysis of the study, a cross-sectional household survey of farmers data were collected during the production year of 2015, from a sample of 150 farm households from Bambasi Woreda, Benishangul Gumuz region. Therefore, as the descriptive statistics reveals that, gender of the household head, use of pesticide, access to credit, use of fertilizer, extension service, farmer to farmer extension, and soil quality are statistically significant that affects the technical efficiency of productivity. And male headed households have a mean difference of 13.78 quintal times higher than their counter parts of female.

Similarly, of the crops produced in Bambasi Woreda, the most commonly grown crop is pepper for around 8.12 quintal of female, 19.11 quintal of male and is statistically significant at 1% probability level of significance. As per the descriptive result shows that, pepper is the most and commonly grown crop across Bambasi woreda plots. And the combined mean difference of the pepper

produced is 14.71 quintal. So, male-owned plots are significantly more likely to be planted with pepper, sorghum, as compared to female owned plots.

As the result of the Tobit model of productivity in quintal indicates that, the variables like gender of the household head, land size in hectare, farmer to farmer extension, availability of electricity and natural logarithm of on farm income are statistically significant and economically meaning full that affects the technical efficiency of the natural logarithm of productivity in quintal. Based on the result, in the rural male headed households are more technically efficient in agricultural productivity. And farmer to farmer extension is a proxy for information and households with farmer to farmer extension are 0.36 quintal times more likely to increase their technical efficiency of the natural logarithm of productivity, *ceteris paribus*.

To sum up, male headed households are more technically efficient in productivity, so, the concerned body of the woreda should encourage females to become efficient as male. And also, conduct research and development to step up the exposure and efficiency of females on productivity too. Furthermore, the local administrator of the Woreda should expand good market condition for pepper production too.

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